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AVIATION AND AIRCRAFT JOURNAL

Aerial View of the Statue of Liberty on Bedloe's Island

VOLUME X
Number 10

Four Dollars a Year

SPECIAL FEATURES

NIGHT OBSERVATION AIRPLANE X.B.1-A
U. S. COMMERCIAL AIRCRAFT COMPANIES
FUEL FEED SYSTEMS FOR AIRPLANES
AIR SERVICE AND CIVIL AERONAUTICS
NAVAL AIR SERVICE INDEPENDENCE

THE GARDNER, MOFFAT CO., INC.
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British Admiralty on Aircraft

THE First Lord of the Admiralty in explaining the British naval estimates for 1920-1921 gave as his opinion that the capital ship was not doomed by aircraft. He is quoted as saying "Nor at present could the Board of Admiralty subscribe to the statement that aircraft have doomed the capital ship. Aircraft are certainly of the highest importance in naval tactics, as regards reconnoissance, torpedo attacks, and artillery observation, but their role in present circumstances is that of an auxiliary and not of a substitute for the capital ship."

This statement was made some time ago, but it is significant that reports from London indicate that the British capital ship program has been temporarily halted.

The Significance of Secrecy

FOR the last two years it has been generally assumed that the United States had complete information of what progress was being made in other countries in aircraft development. Much was written regarding the great improvements that had been made in construction and specialization.

Suddenly, last year, the channels of information seemed to close and now it is almost impossible to learn what the more advanced of our former allies are doing in the expansion of their air services. The prime question of aircraft carriers is a specific instance. Our information on foreign ships of this type is meager and little seems to be forthcoming from the usual channels. Such a condition will give rise to difficulties which may cause the cry for disarmament to take on a new tone. If nations are willing to have their army and navy programs known, but withhold at the same time their air program, the conclusion must be reached that it is in this branch of armament that the most significant developments are taking place.

Length of Tail Surfaces Arm in Monoplanes

IN standard biplane design a rule which is fairly well established is to make the arm of the tail surfaces, or the distance from the center of the horizontal tail surfaces to the center of gravity of the machine about three times the length of the wing chord.

When a monoplane design is employed, excessive span is avoided—with resulting increase in weight of wing construction and unwieldiness—by cutting down the aspect ratio from the customary seven or six to a value as low as four. The chord is thereby largely increased. If the horizontal tail surface area is given the same percentage of the wing area as in biplane practice, it would seem at first sight logical to increase the distance from the tail surface center to the center of gravity in proportion to the increase in chord. This would involve lengthening of the fuselage which means again increase in weight of the fuselage and increase in overall dimensions. What is at first logical is therefore not desirable.

It should also be remembered that if the chord increases in the monoplane very largely, the moment of inertia does not increase in anything like the same proportion. This has a very important bearing on the problem.

If the tail surface arm of the long chord monoplane were made three times the chord length, the degree of static stability would remain what it is for the ordinary biplane, but the relative damping effect in dynamic oscillations would be very greatly increased. Since the damping in an ordinary biplane is ample, this increase in relative damping effect would be superfluous, if not positively undesirable.

It is not suggested that in view of these preliminary considerations, the designer of the monoplane should at once make a radical reduction in proportioning the tail arm, but it is believed that a further consideration of the problem of reducing the tail arm might be worth while.

Aileron Factors of Safety

IN considering the safety of the tail surfaces of an airplane, arbitrary values are generally set for the loads per square foot to be imposed. Sometimes consideration is given to the maximum tail loads possible with reference to the center of pressure movement on the wings. In considering the safety of the ailerons, it would seem that something better than the arbitrary setting of a certain load per square foot is possible.

The loads which can be imposed on the ailerons depend to a certain extent on the pilot's strength. But in a small machine with the narrow chord ailerons of modern practice, the pilot might never have to exert himself greatly to obtain maximum displacement of the ailerons. The question then arises as to what the aileron loads would indeed be related to. They would certainly be related to the loading of the main surfaces and also the factors of safety of the main surfaces. The logical process would be to argue as follows: the normal wing loading is so much, the factor of safety for the wings is so much; under a given maneuver condition the loading on the wings approaches the product of these two values. When the wings are under this heavy load, a maximum displacement of the ailerons imposes a greater local load on the wings. The ailerons themselves have a loading, which from pressure distribution experiments, we know bears a certain ratio to the loading on the wing surface in front of it. From these considerations a fairly sound rule might be deduced, relating the aileron factors of safety to the design of the ship as a whole.

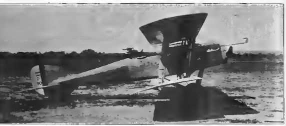
Airship Mooring Masts

THE mooring mast which is illustrated in this issue is an important development which has proved successful. By its use the cost of airship operation will be considerably reduced and greater safety will be achieved.

The Night Observation Airplane U.S.X.B.1-A

The ghost of the Bristol Fighter is seen in the U S X B 1-A, the new two-seater night observation airplane shortly to be sent to units of the Army Air Service along the Mexican border. This machine is similar to the day type in all respects, save that it is fitted with landing flares, lighting system and other equipment for night flying. A machine for this work will eventually be silenced and painted to be as nearly indistinguishable as possible.

The X.B.1-A is, in fact, a development of the Bristol Fighter, which was to have been fitted with a Liberty and put into production in 1917 for overseas use. Changes have been made from time to time during the intervening period until only the general outline remains. For instance, it has



Side View of the X B 1-A Night Observation Airplane

a veneer body and a 300 hp. Wright engine, which is better than the Liberty for high altitude work where a booster is not fitted.

The machine has been tested to show 133 m.p.h. at ground level, and 129 m.p.h. at 6500 ft., down to 83 m.p.h. at 22,400 ft. altitude, the Bristol had a speed of about 119 m.p.h. at 6500 ft. and of 105 at 15,000 feet altitude. Compared with the D H 4 the machine on which production for overseas centered during the World War, the X.B 1 A has the advantage of about 13 m.p.h. more speed at the ground and 9 m.p.h. at 6500 ft. The X B 1 A climbs to 15,000 ft. in 19 min., compared with the Bristol figure of 21 min. 20 sec. to 15,000 ft., and the D H 4 of 24 min.

It will be at high altitude that the pilot will see a big improvement on the D H 4-B. From 15,000 ft. upward it will be found much faster, much more manoeuverable, much lighter on controls and altogether more like a single-seater fighter than any other plane of this type heretofore produced or used by the U. S. Army Air Service.

The flying qualities have been found to be exceptionally good at all altitudes. The airplane is neither nose heavy nor tail heavy, due to the adjustable stabilizer, which is very effective. The airplane can be flown with hands off, it will also glide with hands and feet off controls.

The landing qualities are also very good. It requires about 800 ft. to complete a landing in calm air. There is no tendency to nose over, and it taxies very well, though the rudder is small and the tail skid is not steerable.

Visibility is exceptionally good ahead and above. Pilot and gunner are both able to look ahead, above and below the top wing. The lower wing, of course, as in all biplanes of this type, is objectionable. The locations of the controls in general are very good.

Dimensions

Over-all span, 39 ft., 4 9/16 in.; over-all length, 25 ft., 6 in., over-all height, 9 ft., 9½ in.; height at hub of propeller above ground in flying position, 5 ft., 7 in., at rest, 6 ft., 7 in.

Cell

Wing-curve, modified R A F 15, sweepback, none, dihedral, 3½ deg., stagger, 18 in., total area, including ailerons, 405.6 sq. ft., gap, 5 ft., 5 in.

Upper Plane (Including Center Section)

Span, 39 ft., 4 9/16 in., chord, 66 in., area, with ailerons, 202.8 sq. ft.; incidence, 1¾ deg.

Lower Plane

Span, 39 ft., 4 9/16 in., chord, 66 in., area, 202.8 sq. ft., incidence 1¾ deg.

Ailerons or Flaps

Number, 4. Arrangement, same on both planes, length, 85 in., chord, 23 9/16 in., upper area, 13 sq. ft., lower length, 85 in., lower chord, 23 9/16 in., lower area, 13 sq. ft., total area, 52 sq. ft.; distance from center of ailerons to longitudinal axis of airplane, 16 ft.

Center Section

Area, 17 sq. ft. each, dimensions, chord, 48 in., span, 51 in.; contents, none.

Stabilizer

Area, 22.5 sq. ft., setting, neutral.

Elevator

Area, 11.5 sq. ft., each, distance from leading edge of elevator to C. G. of airplane, 16 ft., 10 in.

Rudder

Area, 7.2 sq. ft.; distance from rudder hinges to C. G. of airplane, 16 ft. 10 in.

Fuselage

Maximum cross-section shape, tangent conoids, maximum cross-section area, 8.3 sq. ft., maximum cross-section dimension, 32 ft. by 45 in., distance of maximum section from leading edge, lower plane, 25 in.

Landing Gear

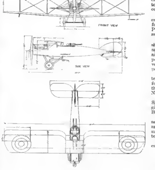
Number of wheels, 2; tread, 66 in.; shock-absorbing system, rubber, braking device, none, wheels ahead of C. G., 12⅝ in.

Fin

Area, 10.3 sq. ft.

Power Plant

One Wright, model H, 300 hp., at 1800 r.p.m., weight, dry, 632 lb.; gas consumption, 0.521 lb. per hp. hr., oil consumption, 0.055 lb. per hp. hr.; weight of water in engine,



Outline Drawings of the X B 1-A Night Observation Airplane

67.9 lb. Two Simms magnetos. One Stromberg carburetor type, NAV-6, with altitude control, effective to altitude of 15,000 ft. Water-jacketed manifold. The radiator was made at McCook Field and is mounted in the nose, frontal area, 3.16 sq. ft.; depth, 4 in., length, 32¼ in.; width 26⅝ in.; radiator surface, 106 sq. ft.; temperature adjustment, vertical vane shutter, water cap, 42 lb.; flow, 47 gal. per min. without overflow, Boyce thermometer, weight, 128 lb. full, 86 lb. empty, type, round tube, hexagonal ends, water capacity of whole system, 105 lb. Remarks, Venturi system, with expansion tank integral with radiator. Exhaust pipe is a 4 in. 1 long manifold. Capacity of two lubrication oil tanks, 4.2 gal., oil pressure, 65 lb.; oil temperature, 50-55 deg. Cent., gear type pump, dry sump. One terneplate fuel tank (54 gal.) back of engine, under pressure, capacity gauge intended as temporary system only.

Distribution of Weight

Weight empty (with water), 2,010 lb.; armament and equipment, 283 lb.; crew, 360 lb.; gasoline, 305 lb.; oil, 36 lb. Weight loaded, 2,994 lb. Weight on front wheels (tail skid on ground), 2,626 lb.; weight on tail skid (tail skid on ground), 368 lb., weight on front wheels (flying position); 2,789 lb.; weight on tail skid (flying position), 206 lb. Center of gravity (distance from wheels in flying position), 1 ft. 1¾ in. Weight/sq. ft., 7.38 lb. Weight/horsepower, 9.98 lb. Endurance, full throttle at 10,000 ft. (including climb), 2.4 hr., minimum speed at sea level (lowest throttle), 59 m.p.h.

Aeronautical Engine Testing Stations

Laboratories for the testing of aeronautical engines, both of old and new design, are located at Dayton, Ohio, for the Army, at the Washington Navy Yard, Washington, D. C., for the Navy, and at Langley Field, Virginia, for the National Advisory Committee for Aeronautics. Upon the request of either the Army, Navy or the National Advisory Committee for Aeronautics, the Bureau of Standards, Washington, D. C., will carry out tests of engines and accessories with special reference to their performance under altitude conditions, in a special laboratory designed for this purpose.

Inventions and new appliances applicable to aeronautical engines may be submitted to the National Advisory Committee for Aeronautics, Washington, D. C., whose Committee on Power Plants for Aircraft may arrange for test by the Government of engines or devices which it may approve.

Unless a designer or inventor can furnish data of interest showing that his proposed engine has passed the research stage and is of immediate value for use in military or commercial aircraft, the Government will not test the engine at its expense. On the other hand, if an engine shows promise of development, either the Army or the Navy will bear the expense of test and of further development.

It is not the policy of the laboratories mentioned to make tests of aeronautical engines for any one who may offer them for that purpose, but to do so only when in their judgment the engine is worthy, or on specific recommendations for the N.A.C.A.

Aircraft engines may be submitted to the Director of Air Service, Washington, D. C., or to the Navy through the Engineering Chief, Chief Bureau of Steam Engineering, Navy Building, Washington, D. C.

Inventions and unpatented new appliances applicable to aeronautical engines submitted to any War Department office must be forwarded to the Inventions Section, Operation Division, General Staff, State, War and Navy Building, Washington, D. C.

There are no government funds available for aiding new enterprises or developing private inventions.

Aviation School Expands

An indication of the growth of interest in flying on the Pacific Coast is the fact that the Dudrey Aircraft Corporation which for the past year has been conducting ground and flying courses at Portland, Oregon recently concluded a five year lease of a building at 105-107 North 11th St. which will give them

Shops have been established so that the shop and lecture work of the school can all be done in the new headquarters. much larger quarters for their school.

It is planned to continue giving the flying instruction at Bloomfield field, where the school maintains hangars and other necessary equipment, it was announced.

The school, which has been in existence less than a year already, has about eighty students, and this number is being rapidly augmented, according to an announcement of the company.

Officials of the school have announced that additions to the shop and other equipment of the school are to be made immediately, looking to making it the most modern aviation school west of the Mississippi river. This will include purchases of machines, airplane parts and airplanes.

Fuel Feed Systems for Airplanes

By L. B. Lent

One of the outstanding lessons learned in over two and a half year's operation of the Air Mail Service is that altogether too much trouble is encountered in the operation and maintenance of fuel feed systems. This constant source of trouble is not peculiar to any one type of plane nor to any particular system, but is found in a more or less degree in them all. It is fair to say that most of the forced landings, not due to bad weather, and a large part of the field maintainance work is caused by trouble with the fuel feed system. If all of it could be eliminated, the work and worry of field crews would be much reduced. There should be no more trouble with the fuel system in a plane than there is in an automobile and it is felt that if this phase of airplane engineering is given the mental effort it deserves we could almost forget the existence of the fuel system, as we now do in our automobiles. It is unnecessary to point out that a faulty system is a potential fire hazard and the possible cause of fatal accidents. This subject merits the best thought that can be given to it.

We will discuss this mater briefly, pointing out some of the features developed in the Air Mail Service, and indicate some lines along which improvement may be accomplished.

Up to the present time there has been no endeavor to standardize fuel systems for airplanes nor their various parts. Each manufacturer seems to have developed a system of his own and thus there are about as many fuel feeds systems as there are makers of planes. This is true even of planes with a single engine power plant. When multi-engine planes are considered, the many tanks and the mass of pipe and connections used causes one to wonder how these systems function as well as they do. But, it also has inspired many designers, and many more mechanics who have to keep this complex system of "plumbing" in order, to give serious thought to developing some system which is more simple, reliable and fool-proof, for it requires no argument to prove that the simpler the system, the less is the danger of trouble.

For the purpose of discussion, the subject may naturally be divided into two parts, that of fuel storage and of fuel delivery. The first deals almost entirely with storage tanks and the latter with pipe systems, connections, valves, strainers, etc., which comprise the delivery system.

Fuel Storage Tanks

Theoretically the strongest shape tank would be one of spherical shape, but it is difficult to manufacture such a shape and other important considerations preclude its use. Next to a spherical tank, a cylindrical one with bumped heads, such as constitutes the shell of tubular steam boilers, possesses the greatest strength per unit of weight.

The consideration which seems to have determined the shape of most tanks is the available space in which to put them. They have been so shaped as to fill as completely as possible the available space in the fuselage. Tanks placed in, or on, or under wings have, of course, been so shaped as to add as little head resistance as possible when flying. In most cases, however, the result is some odd shape with one or more large flat surfaces. Such surfaces must be well stayed with internal plates or tie-rods, especially if the delivery system uses air pressure in the tank to drive the fuel through the system. This pressure added to the inertia forces due to the surge of the fuel totals more than most designers imagine and results in more damaged tanks than is commonly supposed. Many gas tanks removed from DeHaviland and other planes have had their flat sides all bulged out betwen the tie rods and leak badly at both the rods and seams.

It should be unnecessary to mention the fact that a gas tank with its fittings should be amply strong to stand any and all wear and tear of ordinary use, but the many failures seem to indicate that mechanical strength is too often sacrificed to secure lightness. Brazing and soldering are frequently relied upon to carry strains instead of putting all such strains on rivets or other fastenings and only calling on the solder to make the joint gas tight.

It may seem almost foolish to mention such obvious matters, but the experiance of the Air Mail Service shows that many tanks are structurally weak, require much repair and maintainance and hence furnish work for crews which should not be necessary. And it is the sum total of all these little unnecessary jobs which so increases maintainance costs and makes life miserable for the boys on the ground.

When the amount of gas to be stored is comparatively great, say fifty gallons or more, it becomes a question as to the use of one or more tanks. One large tank ordinarily weighs less than two or more smaller ones of the same total capacity, although the larger tank requires thicker metal for the requisite strength. A consideration which is given some weight by designers is that a leak in one of two or more tanks is not as serious as in a single tank, but this applies only when each

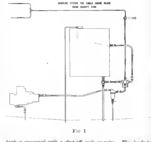


Fig. 1

tank is equipped with a shut-off cock or valve. This leads to complexity rather than simplicity, a thing to be avoided if possible.

It is the writer's opinion that when other conditions do not necessitate the use of two or more tanks, a single tank of the requisite capacity is preferable. Inasmuch as we are discussing commercial machines principally, the matter of bullet-proof, leak-proof and crash-proof tanks can well be left to a consideration of military machines.

A properly built tank should be leak-proof, but it should be borne in mind that at the present time they are not all so built and in many cases it might be advisable to use the so-called leak proof and crash-proof tank. Several of the rubber manufacturing companies have developed very satisfactory rubber blankets or covers which do not add prohibitive weight but which tend to render a gas tank both leak-proof and crash-proof to an astonishing degree.

Gasoline Distributing Systems

Before beginning a detailed discussion of this part of the subject, let us agree and firmly fix in our minds the obvious but most important fact that the one object of all delivery systems is to furnish to the one or more carburetor bowls of the power plant a proper quantity of clean pure gas (preferably at a constant pre-determined pressure) under all conditions of flight. This, of course, means all conditions of

engine loading and all positions of the plane in flight. But a most important consideration is that this must be accomplished while reducing chances of leakage to an absolute minimum, thus lowering or eliminating the fire hazard.

One of the main, but indirect, causes of leakage is the character of the structure in which the storage and delivery systems are installed. An airplane is by no means rigid and is subject to more or less vibration and this in turn induces strains in the piping system carried thereon which are sometimes very severe. It is these vibration strains which are the prolific cause of leakage and rupture, and both occur mostly at joints and connections, so that for airplane work there have been developed types of connections adapted to the work, but which at present are still the source of much annoyance and trouble and sometimes of fatal accidents. That leaks in gas

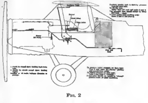


Fig. 2

lines may result in loss of life is sufficient reason why every possible effort should be made to eliminate this source of accident.

Definition of Distribution Systems

The several methods of distributing gas to one or more carburetors of the power plant may be classified as the *gravity* system, the *air pressure* system and *pump* system. Some makers use a combination of two of them in the same plane.

It is presumed that the reader is familiar with these, but it may be well to state that the pure gravity system relies on a difference in relative elevation between the tank and the carburetor bowl to induce a sufficient flow of gas as in the Curtiss JN-4D planes.

The air pressure system employs an air pump, driven by the engine, to create sufficient air pressure in a closed tank to force gas to the carburetor. Such a system is used in the De Haviland machine. In the pump system, some form of pump is used to force the liquid through the system.

Gravity Systems

The gravity system is ideal if a sufficient head can at all times be maintained and kept within certain pressure limits, but in many cases this is quite impossible. The head continually diminishes as any gravity tank is emptied. Furthermore, there are many cases in which it is impossible to instal conveniently the main tank in such a position as to supply sufficient head. For instance in most Liberty engine installations the carburetor in the valley between the cylinders is too high in the fuselage to flow gas to it by gravity from any possible main tank location. Hence, in some Army De Haviland planes, an engine driven air pump supplies air pressure in the gas tank. In the Martin mail planes, using two Liberty engines, auxiliary gas tanks are mounted over each engine in the upper wings and gas pumped to them from the main tanks, thus furnishing sufficient head to the carburetors. This is a typical example of the combination of the pump and gravity system. An overflow is of course provided from the gravity to the main tanks to return the excess gas pumped.

The advantage of the gravity system when it is possible to use it are: simplicity of piping system and connections, positive feed under proper conditions and little danger of failure, due to simplicity.

The disadvantages are: constantly decreasing head as gas tank empties and liability to momentary lack of gas, due to inertia of gas in pipe lines caused by the motion of the plane, such as in bumpy air or in some maneuvers.

Pressure Systems

It should be unnecessary to discuss at length the use of air pressure to drive gas out of the tank and force it through the system to the carburetor, for the system at best is nothing but one means to an end and has little to commend it except expediency in certain cases. Its proper operation is based on

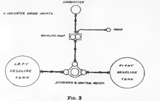


Fig. 3

an air-tight tank, tight air lines and on the proper functioning of a spring-loaded air discharge valve for releasing all excess air pumped and so maintaining a constant air pressure on the tank, and lastly upon the continuous operation of an engine-driven air pump, which however is usually quite reliable.

This system is used on many De Haviland planes in the Air Mail Service and is a source of much annoyance and trouble. Air lines and tanks are difficult to keep tight and the air relief valves are a source of much trouble and need much attention. There is also a combustible mixture of air and gas in the gas tank. One feels fairly safe in saying that this system has served its purpose and will soon go into the discard.

Positive Gas Pump Systems

And now let us consider briefly the positive gas pump system, which in the writer's opinion deserves more consideration and thought than appears to have been put on it until quite recently. It is obvious that, in order to maintain a sufficient quantity of gas under proper pressure at the carburetor, some method of controlling the output of the pump or of returning the excess gas pumped to the main tank must be used. The two methods most used are: An auxiliary gravity tank which is placed at sufficient height above the carburetor to furnish the necessary head, with an overflow from this tank back to the main tank to return the excess gas pumped, or some method of returning the excess gas pumped through a return line containing a spring-loaded check valve which can be set to open at a pre-determined pressure and so maintain the pressure at the carburetor and also return to the suction line or tank the excess gas over that being consumed by the engine.

Types of Pumps

The system has suffered in the past from some lack of simplicity, but more from unreliable pumps. About all types have been used, viz. plunger, gear and centrifugal and in many American machines they have been actuated by some form of wind power, usually a small propeller or anemometer. A pump driven by the engine is much better in all respects. First, because it is positive and runs at a speed corresponding

to the engine's demand for gas, and second, because a proper form of drive puts less strain on the pump than in the present forms of wind-driven pump.

In most wind-driven pumps the speed is much greater than any proper pump speed (except the centrifugal pump) and necessitates intermediate gearing unless excessive pump speeds are to be tolerated and used. Furthermore, it is almost impossible to control the speed of a wind-driven pump. When the engine is idling in a glide, for instance, the pump may be running as fast or faster than when the engine is demanding a maximum quantity of gas, as in level flight or in a climb.

It has happened many times in the Air Mail Service and in other flights that a wind-driven pump has delivered gas to an overhead gravity tank faster than the return line could return it, resulting in much gas being pumped overboard.

Finally, the propeller or anemometer is frequently mounted on the driving shaft of the pump and often puts an eccentric or other strain on this shaft or other parts of the pump which causes rapid and excessive wear or breakage and also makes it difficult to keep the shaft properly packed against leaks. For these and other reasons, the engine drive is more reliable and satisfactory.

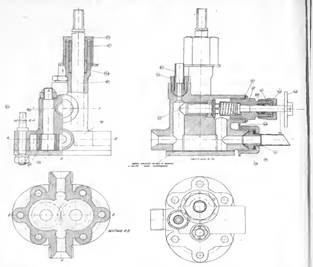


Fig. 4

Much might be said in favor of each of the several types of pumps, viz., piston or plunger pumps, gear pumps and centrifugal pumps, but we will not here attempt to discuss their advantages except very briefly. The plunger pump requires inlet and discharge valves, necessitates some form of gearing to reduce driving speeds and actuate the one or more plungers at their proper speed and so makes such a pump rather complex.

The gear pump is a satisfactory type when properly designed and constructed of the right materials, considering the small amount of work it is called upon to do in furnishing gas to feed one or several engines. It can be the cause of much trouble when not so designed and built, as many have been in the past. In some pumps the stud carrying the driven gear is carried in the cover plate, making it necessary to accurately dowel this plate in place and even then the gears get out of

line and bind and performance is unsatisfactory. The centrifugal pump is the most fool-proof of the various types, but its capacity and discharge pressure are functions of the speed and the head against which it operates and it does not meet conditions as well as might be expected from a superficial consideration of the problem.

It is thought that a good gear pump driven by the engine offers as satisfactory a type for the work as any, unless it be the type developed by the Army Air Service at McCook Field. This is a type of plunger pump using a sylphon bellows as the displacement element and does away with the necessity of packing the driving shaft against leakage. At the present time the cost of this pump is rather high.

Systems Illustrated

A few illustrations showing representative systems will perhaps give a better idea of the necessary pipes, valves and connections than any extended description and may also induce some thought from the reader along the lines of possible and much-needed improvement. Right here, it may be said that it is believed to be better and safer to reduce any system down to the fewest number of essential parts and then make all those parts of proper design and of sufficient strength to

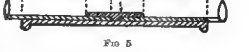


Fig. 5

function correctly, rather than endeavor to provide for all possible contingencies of flight and so complicate the system.

For instance, instead of providing a complete auxiliary feed system to be put into operation in case of failure of the main system, it is better to make the main system so it will not fail, and omit the auxiliary system. We do not use two crank shafts or two cam shafts, because one is liable to fail, but we do build the one crank shaft so that its chance of failure is reduced to a minimum.

A simple gravity system using a single tank with an arrangement for priming the engine in starting is shown in Fig. 1. This system is reliable provided sufficient head can be maintained at all times at the carburetor to supply gasoline satisfactorily to the engine. A small compartment is provided in the upper part of the tank which overflows through small holes into the main tank, and which is used to always supply gasoline when manoeuvering the plane. From this illustration it will be noted that various distributing valves, cocks and other connections provide for about every possible condition of flight. Even this simple system may therefore be somewhat complicated.

Fig. 2 is a diagrammatical illustration of the feed system used in the original Army De Haviland-4 machines. An engine-driven air pump provides sufficient air pressure to drive the gasoline out of the main tank. An auxiliary tank in the upper wing serves as an emergency tank. A hand pump, for pumping air in the main tank in case of failure of the engine-driven pump, adds another piece of apparatus with the necessary piping. A priming system also adds to the amount of pipe and fittings.

In order to illustrate how a complex system may be simplified in accordance with the thought that reliable simplicity is preferable, reference may be made to Fig. 3. Consider a system in which a pump is used to deliver gas from either of two tanks through a duplex three-way valve to the carburetor, with a return line through a spring loaded check valve to either of the two main tanks. The main pump is driven from the engine. A hand pump is inserted in the system to furnish gas to the engine before starting. The obvious first step in simplification is to return the gas from the discharge to the inlet side of the pump through the spring-loaded check valve which can be set to maintain a given pressure in the line running to the carburetor. Thus the excess gas pumped, over that required by the engine, is returned to the inlet side of the pump instead of to the main tanks.

The next obvious step is to embody this return line in the pump and thus do away with the necessary outside piping and fittings. The pump designed for this purpose by C. B. Kirkham is shown in Fig. 4, and the revised system using this type of pump is illustrated in Fig. 3.

It will thus be seen from Fig. 3 that such a system is condensed to an engine-driven pump embodying the return system, a line from the pump to the strainer, and a line from the strainer to the two main tanks. In the machine in which this system is used, the main tanks are at such an elevation that gas runs from them to the pump by gravity, thus obviating the possibility of air-binding the pump from any slight air leaks into this part of the system.

In the system illustrated the only pipe inside the engine compartment of the fuselage is a small length leading from the carburetor bowl directly downward to the point outside of the fuselage just below. From this point the line is run outside the fuselage to the pump and strainer mounted below, with the intake lines also mounted outside the fuselage. Most of the piping is therefore removed from any possible source of ig-

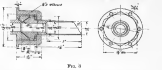


Fig. 6

nition and installed outside where any possible leakage is practically harmless. Furthermore, the chance of the leakage is reduced to a minimum by a reduction of the number of connections necessary, which connections are the potential source of leakage.

Strainers

The matter of pipe connections and fittings might well be the subject of a discussion of its own and will therefore only be dealt with briefly. An essential element of any system is a strainer of sufficient capacity and of sufficient strength to perform its work without possible trouble. The wire gauze strainer should not be of less than 80 mesh screen and an area of 1½ to 2 in. per 100 h.p. is not too much. A good sized bowl with a cock at the bottom should be provided for any accummulation of water, and it should be possible to take out the straining cloth for cleaning without breaking any of the pipe connections.

Pipe Connections

Annealed copper tubing has been almost universally used for conveying gasoline and the common form of coupling used has been rubber hose. This takes care of vibration in the piping, which is a potential source of rupture, but inasmuch as gasoline attacks rubber, it is always a source of trouble from plugged carburetor jets. The common and preferred method is therefore to use a type known as the "Olive" joint shown in Fig. 5 which consists principally of a metal ferrule inserted between the two ends of the joined pipe, which prevents small pieces of rubber from getting into the system.

Metal connections have not heretofore been looked upon with favor, because of their rupture due to vibration. The commercial types of these joints have however not been of proper design to stand the strain. A type of joint, designed by C. B. Kirkham, which has proven quite satisfactory is shown in Fig. 6. The necessary amount of metal is embodied in this joint and provision is made for proper brazing of the pipe to the union. One source of trouble in joints of this character has been that the union has not been screwed home properly and that even then it has not been locked, which may cause it to back off, thus opening up the seat and causing a leak.

While most all parts of a plane are safetied by locks and safety wires, builders seem to have overlooked the proper locking of unions. In the union illustration, a spring washer is inserted as shown. This not only tends to hold the two parts of the union to a seat, but prevents backing off.

While it is possible to cover this subject only in a more or less superficial manner, it is hoped that what has been here presented may lead to a serious consideration of the subject and perhaps to standardize all systems and parts that may be found by a thorough trial to be safe and satisfactory for this important part of airplane performance.

Sperry Buys Interallied Material

The Lawrence Sperry Aircraft Co., Inc., whose aeronautical instruments and automatic controls are well known the world over, has recently purchased the entire stock of Avro planes and spare parts belonging to the Interallied Aircraft Corp.

The Sperry Company is marketing these machines at prices ranging from \$1250 to \$4500 depending on the needs of the customer.

It is understood that Mr. Sperry is bringing out a small sport plane which is a modification of the Messenger he built for the Army, which was described in the Nov. 15 issue of this publication and that he will be ready to demonstrate this plane to the public within a month.

Mr. C. S. Macdonald, formerly secretary of the Interallied Co., is now with the Sperry Co., in charge of sales.

Club Planes for Royal Aero Club Members

It is now possible for members of the British Royal Aero Club to take up their friends for a ride over the country about Cricklewood, London, in one of the club's airplanes or to engage a pilot for the operation of the craft if the member is not, himself, a pilot. At the standard rate of exchange the cost per hour for an Armstrong-Whitworth or B.E.2E. two-seater would be about \$25. A Sopwith "Pup" single seater runs 10 shillings higher. The rates in British money are £5 and £5/10 respectively. These charges include gasoline and oil and insurance of machine and third party in excess of £25.

The conditions of hire are as follows:

1. Flights must be confined to England and within a radius of 250 miles of London, unless special arrangements are made beforehand, and the Members hiring the machine are responsible for its return to headquarters.
2. If the machine is away from headquarters for more than twice the flying time (i.e. time in the air), an additional charge of £2.2.0 for every 24 hours or part thereof will be made.
3. A machine may not be hired for less than half-an-hour.
4. If a Member uses up his supply of petrol or oil before returning to headquarters, an allowance will be made to him for the extra petrol and oil purchased, on production of receipt for same.
5. Members may carry passengers, but not for hire or reward.
6. A register of pilots who are willing to take up Members hiring machines is kept at the Club.
7. The pilot of the machine must hold an Air Ministry License.
8. The Club cannot accept responsibility for injury to the Member, or his friends, or pilots, or for damage to any machine hired by any Member, or injuries to third parties or their property, during, or in connection with any flight.
9. All communications as to hiring of machines must be made direct to the Secretary, Royal Aero Club, 3 Clifford Street, London, W.1.

H. A. Bruno with Aeromarine

Henry A. Bruno who, for the past year and a half was employed by the Manufacturers Aircraft Association in their publicity work, since January 1 has been in charge of advertising and sales for the Aeromarine Engineering and Sales Co., Inc., Times Building, New York.

Third Annual Aviators Ball

The Third Annual Aviators Ball will be held this year at the Waldorf Astoria on Thursday, April 7, 1921. Owing to the unprecedented success of the Ball, both in 1919 and 1920, when the capacity of the Ritz-Carlton was greatly overtaxed, the Ball Committee has engaged the entire second floor of the Waldorf, which allows half as much more dancing space for the coming Ball. The tickets will cost the same as in past years—five dollars plus fifty cents war tax per person.

The four Committees of Patronesses, Patrons, Juniors and Aviators will have charge of the Ball, and the members of these committees will be just as representative as on the previous memorable occasions. All communications should be addressed to the Ball Committee Headquarters, Aero Club of America, 11 East 38th St., New York.

Long Distance Flying

(The following article, setting forth the importance of long distance flying, is of special significance as it comes from Captain Howard Douglas, A. S., the Pathfinder of the Alaskan Expedition.—Ed.)

Since the close of the war, the Air Service of every important country in the world has been conducting long distance flights. One of the first and one of the most spectacular was the crossing of the Atlantic Ocean in a land plane in a non-stop flight, and also of supreme value was the splendid performance of the U. S. Navy in crossing the Atlantic in a seaplane. The English air force has carried out flights to Australia and from Cairo to Cape Town. The Alps have been explored by airplane and flights from France to Northern Africa have been carried out. In the United States, the Army Air Service has conducted a transcontinental reliability test, a transcontinental flight from San Diego, California to Jacksonville, Florida, a flight around the rim of the United States of almost 10,000 miles, and a flight from New York City to Nome on the Bering Sea and return, a distance of approximately 9,000 miles.

There are still individuals, presumably of average intelligence, who will ask the question, "Why are these dangerous flights attempted?" It is a matter of courtesy to explain the reasons for such expeditions, but to the person who has paid any attention to aeronautics and its development, the reason is very obvious.

It is only the attempt to accomplish difficult things that will develop aviation. Long distance reconnaissance flying has met with such unqualified success during the past year that it is possible to foresee the time when no part of the world will be inaccessible to airplanes. It has not been the policy of the United States Army Air Service to wait for the time to come when airplanes, specially designed for long distance flying, were built. Using the equipment we have had at hand for war purposes, we have successfully accomplished flights that a few years ago would have been considered impossible. We have carried flying operations into parts of the world where airplanes have never been before. On the Alaska trip, there was country traversed which no man had ever seen before. The exploratory value of such flights as these is unlimited. It demands a daring imagination to even estimate the extent and future possibilities of aerial exploring.

Aside from the exploratory value of long distance reconnaissance flights, there is a very material military value. Experience and training, impossible of attainment by any other means, is to be had. Pilots and mechanics, who participate in such flights, carry on operations thousands of miles from their base. Every long distance flight ever attempted has given the flying personnel engaged a wonderful opportunity to study the art of flying. It affords the best opportunity to check the value of navigating instruments. Every flight has its own individual problems involving mechanical operation, supply and navigation. The successful solution of all these problems is the best possible training for Air Service personnel. Practice flying around an airdrome is essential, but however important such flying may be, it cannot compare in any way with long distance cross country flying. These flights already successfully carried out have done more than any one thing to foster and develop commercial aviation, and from a military standpoint, the experience and training gained have been invaluable.

U. S. Commercial Aircraft Companies

Prepared by the Manufacturers Aircraft Association

After careful examination of Air Service manufacturers and operators reports, the Manufacturers Aircraft Association estimated that there were on Jan. 1, 1921, one thousand aircraft in commercial use in the United States and Canada.

Due to the itinerant nature of much of the flying, and the lack of any federal system of registration it was impossible to trace the activities of all these machines. But comprehensive reports were received from eighty-eight companies, controlling nearly five hundred machines. On this basis it is estimated that the one thousand aircraft flew six million miles and carried approximately 225,000 passengers. The Manufacturer's Aircraft Association reports that during 1920 the Army Air Service flew 6,250,000 miles, Naval Aviation 1,500,000 miles, and the Air Mail, 1,500,000 miles. The total mileage in the air is estimated at 15,250,000.

COMMERCIAL AIRCRAFT OPERATING COMPANIES IN THE UNITED STATES AND CANADA

	Name of Company	Address	Aircraft	Air Port Facilities	Charge Short Flight	Charge Pas.-mile Inter-city Flight	Passengers Carried	Freight Carried	Miles Flown
1	Aerial Tours Co.	Seattle, Wash.	1 B.B.L.2 1 J.N.-4	Field (rented) and hangars at Kent, Wash.	\$15.00	\$1.00	1,700	0	31,500
2	Aeromarine Sight-seeing & Navigation Co. (merged with Aeromarine West Indies	86th St. & Riverside Drive, N. Y. City	2 F-5-L Navy Cruiser Flying Boats; 2 50-B-2 Flying Boats	Terminal at 86th St. & Hudson River.		.83	600	0	7,000 (est.)
3	Aeromarine West Indies Airways, Inc.	Key West, Fla.	6 F-5-L Navy Cruisers (14 passenger)	Terminals in harbors at Key West & Palm Beach, Fla.; Havana, Cuba; Bimini and Nassau.		\$75 oct. Key West and Hav	300		7,200
4	Aero Limited	20 W. 34th St., N. Y. City	15 5-passenger H.S.-2 L. Flying Boats	Air ports (owned) at Flushing and Miami.	10.00 to 25.00	.80	4,376	1,500 lbs.	200,000
5	Air Service, Inc.	536 Broad St. Newark, N. J.	1 Canadian J.N.-4 OX5 motor	Field 1500 x 3000' (leased). 1 hangar under construction	10.00	.85	1,473		13,800
6	Air Transport & Photographic Co.	302 Sloan Bldg., Cleveland, O.	1 Canadian J.N.	Field (leased) tent hangar; hangar for 10 machines and repair shop.					unknown
7	America Trans-oceanic Co.	305 Fifth Ave., N. Y. City.	1 H. 16, 1 H.S. 3 Seagulls 1 F Boat.	Pt. Washington, L. I.; Palm Beach and Miami, Fla.; Bimini & Nassau, Bahamas	10.00 to 15.00	.46	4,000		80,001 (est.)
8	Augusta Aircraft Co. Inc.	Augusta, Ga.	2 J.N.-4-D's.	Field (owned), hangar and supply depot		1.00	1,000		15,000
9	Bealy Aviation Co.	Dallas, Tex.	2 J.N.-4-C's.	Field (owned) at East Dallas, and Gaston Ave. Dallas, Tex.; shop and repairs.	10.00	.40	515		6,135
10	E. B. Bridges	Anderson, Ind.	1 J.N.-4-H.†	Field (rented) 32 acres, tent hangar, supply depot.	15.00	\$60.00 (an hour)	220		8,160
11	Canadian Aerial Services, Ltd.	Hempstead & St. Lawrence Blvd., near Montreal, Canada.	1 504-K 1 J.N.-4-C	1 hangar at Hempstead for 2 machines. 1 hangar at St. Lawrence Blvd. for 1 machine. Fields at both (rented).	10.00	.75	445	240	9,283
12	Canadian Aircraft Co. Ltd.	Winnipeg, Canada	3 504-K's; 2 Canadian J.N.-4's.	Field with hangar and shop at St. Charles, Winnipeg.	10.00	1.00	1,500	900	12,003 (est.)
13	Cassell Motor Co.	Santa Fe, N. M.	1 J.-1 †	Field (owned) with 1-ship hangar equipped with repair shop, gas and oil facilities.	12.50	1.00 per min.	900	900 lbs.	10,001
14	Chattanooga Auto Co. (Aerial Depot)	Chattanooga, Tenn.	3 Canadian J.N.'s 2 J.N.-4-D's, 1 J.-1; 1 Oriole K.-6.	Field (leased) hangar, supply shop.	15.00	.75			
15	Checkerboard Airplane Service	Forest Park, Ill.	7 Canadian and American J.N.'s and J.-1's.	Field (owned), 1 hangar 8-plane capacity service depot complete.	10.00	.50 to 10 p. mi.	2,000 (est.)		25,000 (est.)
16	Chenoweth Aviation Co.	Richmond, Ind.	1 J.N.	Field (owned) with hangar for 3, shop and supply depot.	10.00 to 15.00		300		3,500 (est.)
17	Chester R. Clark Aerial Service Co.	1563 Franklin St., Oakland, Calif.	2 OXX6 J.-1's; 1 Boat.	2 fields (owned), 2 hangars (one under construction)	1.00 per min.	1.00 per min.	1,476		15,000 (est.)
18	Cincinnati Aircraft Co.	Duck Creek Rd., Cincinnati, O.	2 Canadian J.N.'s.	Field (owned) 2680 x 2900 ft., hangar 50 x 125 ft.	15.00		400		4,000 (est.)
19	Colorado Aviation Corp.	Glenwood Springs, Colo.	1 J.-1 1 monoplane *	1 field (leased)	12.50	.50	1,500		20,000
20	Concord Aircraft Co.	80 N. Main St., Concord, N. H.	1 Canadian J.N. 1 504-K.	1 field (rented) with hangar, shop, office.	10.00	.80	600		10,000
21	Connecticut Aerial Navigation Co.	886 Main St. Bridgeport, Conn.	Seagulls M.F. Boat.	Seaplane base (leased) with hangar and storage facilities, etc. Black Rock Harbor Bridgeport; landing field 3 mi. east of Bridgeport.	1.00 per min.	1.00	392		7,000
22	Curtiss Aeroplane & Motor Corp. (Main Company)	Mitchel Field, Mineola, L. I. New York.	Orioles, J.N.'s. J.1's, Seagulls, Eagles.	Field (owned) mile square near Mineola; hangars, supplies, etc.	15.00	1.00	1,000		25,110
23	Curtiss Aeroplane & Motor Corp. (Western Branch)	30 N. Michigan Blvd. Chicago, Ill.	Orioles, Seagulls, J.N.-4-D's, Canadian J.N.'s, J.-2's, Eagles.	2 fields (leased) at (1) Sheridan Rd. north of Waukegan; (2) Roosevelt Field at Des Plaines River	10.00		125		1,600

COMMERCIAL AIRCRAFT OPERATING COMPANIES IN THE UNITED STATES AND CANADA — *Continued*

	Name of Company	Address	Aircraft	Air Port Facilities	Charge Short Flight	Charge Per mile Inter-city Flight	Passengers Carried	Freight Carried	Miles Flown
24	Curtiss Eastern Airplane Corp.	130 S. 15th St. Philadelphia, Pa.	4 Orioles, 1 Seagull 2 J.N.-4-D's.	Landing field with 2 large hangars, repair shop, office, etc., at Pine Valley N. J.	$10.00 to 15.00	$ .75	1,000		102,000
25	Curtiss Exhibition Co.	Kenilworth Field, Buffalo, N. Y.	2 Orioles, Canadian J.N., 4 J.N.'s, 2 K.-6 J-1's; 1 OX J-1	1 field (rented) n. e. of Buffalo, with 2 hangars, shop, etc.	15.00	1.00	1,035		10,000
26	Curtiss Flying Station	Atlantic City, N. J.	1 C.-6 Seagull 4 K.-6 Seagulls 2 J.N.'s 1 K.-6 Oriole	Seaplane base at inlet and airport (both owned), 1 seaplane hangar 300 x 100, 2 field hangars 8-machine capacity, shop, etc.	15.00	1.50	2,200		30,000
27	Curtiss-Humphreys Airplane Co.	Denver, Colo.	5 Orioles 3 J-1's	Field (leased), hangars, shops.	12.50	1.00	3,500		35,000 (est.)
28	Curtiss-Indiana Co.	Kokomo, Ind.	30 to 30 planes J.N.-4-D Canadian J.N., J-1, Orioles, Bomber**	80 acre field (leased) ½ mile s. e. Kokomo, with hangars, shops, etc.	15.00	.50 to .75	12,000 (total)		500,000
29	Curtiss Iowa Aircraft Corp.	Fort Dodge, Ia.	4 Orioles 6 J.N.'s	63 acre field (owned) Ft. Dodge; 140 acre field (leased) Des Moines, hangars, shops, service stations both fields.	10.00				
30	Curtiss-New York Aircraft Corp.	319 Main St. Buffalo, N. Y., & 600 Fifth Ave. N. Y. City	16 planes Seagulls, Orioles, J.N.'s, J-1's.	Fields (owned) N. Y. City (Mineola, L. I.) and Buffalo, N. Y.					
31	Curtiss Northwest Airplane Co.	707 Metropolitan Bank Bldg. Minneapolis, Minn.	6 J.N.-4-D's, 6 J-1's, 3 Orioles.	Field (owned) 680 x 440 yds. bet. Minneapolis & St. Paul cor. Snelling & Larpenteur Aves. 2 hangars for 8 ships & 4 ships respectively, 2 shops.			3,000	800	250,000
32	Curtiss Southwest Airplane Co.	Tulsa, Okla. Ft. Worth, Tex. Dallas, Tex. Houston, Tex.	3 K.-6 J-1's 2 K.-6 Orioles 5 OX5 J-1's 6 J.N.-4-D's 4 Canadian J.N.'s	Terminals at Tulsa & Ft. Worth 140 acres ea. with hangars, shops, supply depots (both owned), fields (leased) with supply depots at Dallas and Houston	10.00	.80 to 1.00	1,500 (est.)	8,400 (est.)	25,000 (est.)
33	Earl P. Cooper Airplane & Motor Co.	San Francisco, Calif.	3 Orioles 2 J-1's, 1 J.N.-4-D	Field (leased)	10.00	1.00	944		40,500
34	Earl S. Daugherty	Long Beach, Calif.	1 J.N.-4-D, 1 Cand. J.N., 1 tractor***	Field (owned) with 3 hangars and supply depot.	10.00	.75	4,300		45,000 (est.)
35	Dayton Wright Co.	Dayton, O.	1 K.T. 1 O.W.	Field (owned) with hangars, supply depot, shops, etc. at Moraine City, Dayton, O.			250		10,000
36	DeLuxe Air Service, Inc.	Deal, N. J.	4 Canadian J.N.'s	Fields (rented) at Deal & Spring Lake, N. J.; hangar and shop at Deal	10.00 to 15.00	.75	500		20,000
37	Dixie Flying Corp.	Birmingham, Ala.	J.N.'s	Field (owned), hangar, etc.			400		4,000 (est.)
38	Eastern Aircraft Corp.	140 First St. Boston, Mass.	J.N.-4's	Fields (rented) at Boston & Springfield, latter station fully equipped	10.00	1.00			30,000 (est.)
39	Finger Lakes Air Service, Inc.	Auburn, N. Y.	1 H.S.-2 Flying Boat				235		2,000 (est.)
40	Ft. Wayne Aviation Co.	Ft. Wayne, Ind.	2 J-1's	Field (owned) 80 acres, with hangars, supplies, etc.	15.00	.80	150		1,500 (est.)
41	L. D. Friat Aeronautical Co.	Milwaukee, Wis.	1 J.N.-4-D 1 Canadian J.N.	Field (rented) and large hangar	10.00	.75	800		15,000 (est.)
42	Valentine Gephart, Inc.	Kansas City, Mo.	16 planes, J.N.-4's, J-1's**	Field (owned) 100 acres, hangar 100 x 200 ft., shops, etc.	10.00 to 15.00	1.00			420,000 (est.)
43	Goodyear Tire & Rubber Co.	Akron, O.	1 Pony Blimp, 3 place.	Airship stations (owned) at Akron, Los Angeles & Avalon, Catalina Islands.			400 (est.) (at Los Angeles)		6,000 (at Los Angeles)
44	Green Bay Boat Club	Green Bay, Wis.	1 J.N.	Field (owned) and hangar with supply depot.	10.00		500		5,000 (est.)
45	Gulf States Aircraft Co.	Shreveport, La.	4 planes, J-2's and J.N.'s.	Use State Fair Grounds, Shreveport, La.	10.00	.75	1,000		30,000
46	Fred'k. H. Harris	Brattleboro, Vt.	1 J.N.-4-D	Uses Fair Field one mile north of Brattleboro	15.00	1.00	100		2,000
47	Heddon Aviation Co.	Dowagiac, Mich.	2 Canadian J.N.'s 1 Swallow*	Field (leased) 40 acres, with hangar and supply depot.	10.00	-			6,000
48	Holbrook & MacLeod	Hanna, Atlanta, Ga.	1 J.N.-4	Field (leased) at Hanna, Atlanta, Ga.	10.00	.75	1,200		40,000
49	Hubbard Air Transport Co.	Seattle, Wash. & Victoria, B. C.	2 B.-1 Flying Boats.	Harbor terminals at Seattle and Victoria.			25		1,000
50	Jaquith Flying Station, Inc.	317 Guarantee Trust Bldg., Atlantic City, N. J.	2 Model 50-B Flying Boats.	Platform office etc. at Madison Ave. and Boardwalk.	15.00	1.50	1,200		30,000
51	O. K. Jeffery Airplane Co.	Wilcox Bldg. Portland, Ore.	504-K and J-1's†	Field and hangars (owned) at The Dalles and Bend, Ore.	10.00	1.00	50		500
52	LaCrosse Aerial Co.	LaCrosse, Wis.	1 J.N.4-D.	Tent hangar (owned)	10.00	.75	1,500		15,000 (est.)
53	LaGrande Aircraft Co.	LaGrande, Ore.	3 J-1's†	Fields (rented) at LaGrande, The Dalles and Bend, Ore. Permanent station at LaGrande.	10.00	.45			
54	Leschi Aerial Taxi Co.	Seattle, Wash.	Model C Twin float seaplane.	Harbor terminal at Seattle	15.00		600		9,000
55	David B. Lindsay	Marion, Ind.	3 Curtiss J.N.-4-D's.	Field (rented) with temporary hangar etc. ½ mile se. of Marion.	15.00	.75	927		12,000
56	New York Aircraft Exhibition Corp.	Troy, N. Y.	1 Canadian J.N.	Field (rented) at Troy, N. Y.	15.00		200		5,000
57	Floyd J. Logan Aviation Co.	Cleveland, Ohio.	2 Canadian J.N.'s. 1 J.N.-4-D 1 J-1	Field (leased) on Lindale Rd. near Cleveland, 3 canvas hangars for 10 planes, shop, supply, etc.	15.00	1.00	600		10,000
58	Lynchburg Air Service Corp.	Lynchburg, Va.	2 J.N.-4-D's, Orioles, J-1's.	2 fields (rented) near Lynchburg, one hangar and shop.	15.00		200		3,500 (est.)
59	A. C. McMann	Bettendorf, Ia.	1 J.N.-4-D	Field (owned) east of Bettendorf with hangar and shop.	15.00		500		5,000 (est.)

COMMERCIAL AIRCRAFT OPERATING COMPANIES IN THE UNITED STATES AND CANADA — *Continued*

	Name of Company	Address	Aircraft	Air Port Facilities	Charge Short Flight	Charge Per mile Inter-city Flight	Passengers Carried	Freight Carried	Flown Miles
60	Martin-Sweet Motor Co.	Denver, Colo.	3 J-1's†	Field (owned), 40 acres, with 3 plane hangar and shop.	$15.00		1,000		30,000
61	Mercury Aviation Co.	Hollywood, Calif.	7 J.N.-4-D's, 2 J-1's,† 2 J.L. monoplanes.	3 fields (leased), 2 at Hollywood, 1 Pasadena, 3 hangars at Hollywood, 1 Pasadena; repair shops.	5.00		15,000 (total)		475,000
62	Morrow Aircraft Corp.	Charlotte, N. C.	1 Oriole, 1 J.N.-4-D 1 Canadian J.N.	Field (owned) at Charlotte, N. C.	15.00		600		7,000
63	National Airway Service Co.	217 Walsh Bldg. Akron, O.	2 J.N.-4's.	Field (rented) at Akron, O., with hangars, repair shops and supply depot.	10.00				
64	Northwest Aircraft Corp.	Newell, S. Dak.	1 J-1.	Field (owned), hangar and shop 30'x 50'	10.00	$ .50	100		8,000
65	Ohio Flying School & Transport Co.	53 Central Office Bldg. Akron, O.	5 J.N.-4's.	Field (owned) 8 mi. n.e. of Akron, 80 acres, hangars, supply depot, shops.	15.00	1.00	600		3,450
66	Oregon, Washington & Idaho Airplane Co.	Portland, Ore.	3 Orioles 2 Seagulls 4 F Boats 5 J.N.-4-D's, 1 J-1.	Terminals at Portland, Astoria, Seaside, Vancouver, Marshfield, Salem, Eugene, The Dalles; 12 hangars, shops, offices, etc., Portland hangar accommodates 18 airplanes.	10.00		3,852	25,000	74,000
67	Orlando Aerial Co.	Orlando, Fla.	3 J.N.-4-D's.	Field (owned) 2 mi. west of Orlando.	15.00				
68	Osgood & Stickney	Springfield, Vt.	2 J-1's 1 J.N.-4-D	Field (rented) with hangar and supplies at Springfield.	15.00		3,000		4,500 (est.)
69	Rankin Aviation Co.	Walla Walla, Wash.	1 J.N.-4, OX motor 1 J-1, OX motor	Emergency field at Walla Walla.	1.00 min.	.50	862		30,000 (est.)
70	Foster Russell Aviation Co.	Spokane, Wash.	1 Oriole, 1 J.N.-4-D, 1 J-1	2 fields (leased), one at Spokane and other at Walla Walla.	10.00	.50	1,500		
71	Saginaw Aviation Co.	Saginaw, Mich.	1 J.N.-4-D, 2 J-1's.	Field (leased) Saginaw East Side, 1 mi. from city, hangars, shop, supplies.	12.50	.50	1,460		15,001 (est.)
72	Santa Maria Aviation Co.	Santa Maria, Calif.	3 J-1's.	Field (leased) at Santa Maria, Cal., ½ mile square, 1 hangar	15.00				
73	Security Aircraft Co.	Minneapolis, Minn.	Orioles, J.N.'s, J-1's, 504 K's.	Field (owned) Minneapolis, hangars, shops, etc.	15.00	1.00	3,000		12,000
74	Service Aviation Training & Transportation Co. Inc.	Wabash, Ind.	11 Canadian J.N.'s.	Field (owned) at Wabash, Ind.; hangar 120 x 85', shop, etc.	10.00 to 15.00	.75	9,355		90,000 (est.)
75	Miss Neta Snook	828 Wilson Ave., Ames, Iowa.	1 J.N. biplane.	Air terminal at Ames, Ia., hangar, supply station.	10.00 to 15.00		852	600	2,000
76	Starkey Battery Co.	Muskogee, Okla.	2 under construction.	Field (owned) west of Muskogee.	10.00		2		30 (est.)
77	Southern Aeroplane Co.	11 S. Church St., Charlotte, N. C.	3 F-40 & F-46.	Terminal at Charlotte, N. C. and Fairmont, W. Va. (one owned, one leased) hangar and supplies at Charlotte.	15.00	1.00	1,240	1,100	30,000
78	Southern Wyoming Aircraft Co.	Cheyenne, Wyo.	1 J-1	Use municipal field, all supplies available.	15.00	2.00	500		15,000
79	Syracuse Aero Corp.	239 Union Bldg. Syracuse, N. Y.	3 J.N.-4-D's.	Field (rented) n.e. of city, hangar for 6 planes, service station	15.00	.75			
80	Tahoe Aviation Co. W. S. Stoddard Aviation Co.	Lake Tahoe, Calif. Honolulu, T. H.	1 N-9 seaplane,† 1 J.N.-4-D	Fields (owned) at Lake Tahoe and Honolulu, hangars and runway (under construction) at Honolulu.	10.00		150	2,000	2,000 (est.)
81	U. S. Aircraft Corp.	1803 3rd Ave. Spokane, Wash.	4 J-1's.	Field (owned) with 8-plane hangar, supplies, etc., 1 min. from city	10.00	1.00	551		11,000
82	Utah Airplane Co. Inc.	343 S. Main St., Salt Lake City, Utah	1 Oriole.	Field (rented), Salt Lake City	12.50 to 15.00	.25	275	150	8,000
83	Vancouver Island Aerial Service	Comox Harbor, B. C.	1 J.N.-4-D converted to seaplane.	Use harbor floating-hangar and shop.	10.00 to 15.00	.75	283	600	11,000
84	Walter T. Varney Aeroplanes	832 Post St. San Francisco, Calif.	6 J-1's, 2 J.N.-4-D's, 1 Tourer**	Field (owned) at Redwood City, Cal. 2 mi. x ½ mi., hangars and supply depot.			800		45,500
85	Waterloo Aero Transportation Co.	Waterloo, Ind.	1 Canadian J.N.	Field (rented), 1-plane hangar, shop.	10.00	.75	330		3,305 (est.)
86	Western Aeroplane & Motor Corp.	Casper, Wyo.	1 J.N.-4, 2 Orioles, 2 J-1's.	Field (leased), hangar for 5 planes, complete shops, etc.	10.50 to 15.00	1.00	500	800	4,000
87	Yakima Aviation Co.	Yakima, Wash.	1 J.N.-4-D, 1 J-1	Field (owned) at 3rd St., So. Yakima, Wash., 1 hangar, shop, etc.	15.00	1.00	2,520		12,000
88	Zenith Aviation Co. Inc.	Santa Barbara, Calif.	2 Canadian J.N.-4's.	Field (leased) with hangars, supplies, shop etc., at Ocean Blvd., seaplane landing dock.	5.00	.50	1,400		20,000
	Total		365 to 400	128	$12.50 (av.)	$ .80 (av.)	115,163	41,950 lbs.	3,136,550

KEY TO AIRCRAFT AND ENGINE TYPES

50 and 50-B-2 three-place flying boats, Aeromarine engine; F-5-L Navy Cruiser, fourteen-place flying boats, Liberty engine; built by Aeromarine Plane and Motor Company, Keyport, N. J.

B.B.-L. three-place land plane, Hall-Scott engine, B-1, two or three-place flying boat, C, twin float seaplane, built by Boeing Airplane Company, Seattle, Wash.

J.N.'s of the various types, two-place land planes; Oriole, three-place land plane; Seagull, three-place flying boat; F and M.F., two and three-place flying boats; Eagle, ten-place land plane; H.S. and H-16, six to sixteen-place flying boats; OX, K and C engines, Liberty engines in larger types; built by Curtiss Aeroplane and Motor Corporation, Garden City, L. I., New York.

K.T., two-place land plane; O.W., three-place land plane, Liberty engine; built by Dayton Wright Company, Dayton, O.

J-1 and J-2, two and three-place land planes built by Standard Aircraft Corporation, Elizabeth, N. J., and rebuilt by Curtiss Aeroplane and Motor Corporation or others.

† indicates Wright engine built by Wright Aeronautical Corporation, Paterson, N. J.
‡ indicates Liberty engine built by Packard Motor Car Company, Detroit, Mich.
§ indicates engine built by Hall-Scott Motor Car Company, Berkeley, Calif.
F-40 and F-46, French Farman; J.L. monoplane, German Junker; 504-K, British Avro; * Lark monoplane; ** French Breguet; *** Daugherty tractor; * Laird landplane; ** British Bristol.

The operating companies report a total of 222 forced landings and 88 accidents.

(The above is based upon statements made to the Manufacturers Aircraft Association, Inc., in response to questionnaires sent to all known operators of aircraft. No opportunity has been available to determine the accuracy of the information and no responsibility is taken for the data except for the care with which the figures and facts are reported and the manner in which the summary is presented.)

A Sensation in Co[m]mercial Aeronautics!

WHAT HAPPENED!

WHEN THIS FULL PAGE ADVERTISEMENT WAS PUBLISHED IN *THE NEW YORK TIMES* IT CREATED A SENSATION

Pilots, managers of amusement resorts, yacht clubs, resort hotels, pulp and paper companies and aerial sight-seeing and passenger-carrying companies were quick to realize what an opportunity this was to purchase Aeromarine Navy six-passenger flying boats at less than one third of their original cost.

In the Spring, when the supply of these boats is exhausted, the far-sighted men who order now will be able to double their money, for the simple reason that the boats can not be duplicated for less than $20,000. each, and it is already apparent that the supply WILL be exhausted.

One of these boats earned for its owner last season upwards of $1,000. per week.

The possibilities for next season are much greater, because the public now realizes that flying boats are not only absolutely safe, but the most delightful mode of travel.

The Aeromarine Company has invested hundreds of thousands of dollars in successfully operating flying boats for commercial purposes. All of this valuable experience is at the disposal of companies operating Aeromarine flying boats. The supply of boats is limited. Send for booklet and further information to-day.

THE NEW YORK TIMES, WEDNESDAY, JANUARY 12, 1921

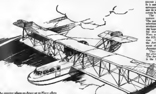
[Go]vernment Takes Big Step to Encourage Aviation

[Advertis]es the Sale of the Famous Navy Coast Patrol HS2 [L] Boats Valued at $18,480 Each for $6,160 per Boat

[De]tails of the Plan, of Special Interest to Automotive Men, which Will [Pla]ce the United States at the Head of the World in Commercial Aviation

always cushioned, always constant, perpetually unchanging in character, with little friction and no jars and jolts. No charm equals the fascination of flying. As soon as people fly they realize why all doubt has been removed from aviation.

The hundreds of thousands of people who use the air liners between London and Paris have come to regard them as safe and certainly more comfortable than the channel steamers. The people who are flying daily between Havana and Key West have welcomed air liners as a veritable godsend after the disagreeable experience [of the] trip over the choppy waters of [the] Gulf.



Navy HS-2-L Flying Boat (Unconverted) F. O. B. Naval Base- Philadelphia, New York, Pensacola and San Diego **Price . $6,160.00** *immediate delivery*	*Aeromarine-Navy HS-2-L Six Seat, Open Cockpit Flying Boat, Model 85.* **Price . $6,500.00** *immediate delivery*	*Aeromarine-Navy HS-2-L Six Seat, Enclosed Cabin Limousine De Luxe* **Price . $6,000.00** *immediate delivery*

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Aeromarine Sales Service Includes the Securing of [Competent] Pilots and Mechanics. We Also Have an Easy Payment Plan Which Makes It Possible to Pay for The[m, i]n Part, out of Their Earnings. Wire - Write - Phone.

Naval Air Service Independence

By Captain T. T. Craven

Director of Naval Aviation

The Navy retains the view that the aeronautical arm should be molded completely into the naval organization. Otherwise it can not have that full sympathy and support which comes only through close familiarity and community of interest. The complete effectiveness of aviation in distant overseas operations can not be developed except through close and intimate association with a naval power; consequently, the advancement of Fleet Aviation will be retarded if the aeronautical branch is in any degree separate and exists otherwise than as a definite and integral part of the Naval Service.

The retention of Aviation as a concrete part of the organization of the Navy and also of the Army may be defended under three separate heads.

Economy

The first is that of economy If an entirely separate and distinct organization for the control of Aviation is created, the elaborate systems now in existence in the Navy and the Army for the procurement and transportation of materials must be duplicated in this new organization A new personnel and another medical department, together with a legal section containing the offices of a Judge Advocate and Solicitor, must be created for the new service. The radio and communication organizations now existing in these older departments of the Government must be duplicated. Another public works as well as a new ordnance department must come into being The Navy and the Army today lend freely to Aviation to the value of many millions of dollars through the various bureaus and offices existing in their organizations. Naturally they could not continue to do so with the Aviation branch under a separate Governmental Department.

It can be clearly shown that with the establishment of a new, separate and distinct department of the Government all of these activities, as enumerated above, must be recreated, with a considerable increase of expense to the Government for salaries to cover the cost of the many new positions which must of necessity come into existence Incidentally, it may be noted that as a part of the proposed organization of a great new department of the Government, additional housing facilities and public works to accommodate the new branch in Washington and elsewhere must be provided separate and distinct from those now existing.

Production of Machines

The second heading under which may be discussed the proposition of combining all of Aviation in a single and new department is that of the production of machines The proposition to produce under a single head and under one organization is alluring, but will not stand close scrutiny, as the Aviation art is in its present experimental condition The Navy has not yet developed the type of machine suited to its needs, and until the present it has struggled with the seaplane or with adaptations of the Army types. Land machines, land tactics, and knowledge of over-land Aviation in general are well advanced. The contrary is true, insofar as the perfection of Naval apparatus and of Naval Aviation methods are concerned

The time to standardize in Naval Aviation has not yet arrived. In developing the Naval plane, the operator must work closely in conjunction and in sympathy with the designer and the manufacturer Both must have intimate and personal knowledge of Naval needs, and such can not be the case with a combined and separate production system, and such a plan would not insure to the Navy the type which it desires or the quantities in which these should be supplied to our fleets.

In passing, attention may be invited to the fact that the Navy is accustomed to delivering attack from ships and also to resisting the attack of ships. It hopes to utilize Aviation for both these purposes. The Navy is constantly experimenting and working with weapons and devices for increasing the power of its attack and also for increasing the strength of its resistance With these details the Army has never been particularly and intimately concerned, and can not be as well informed as is the Navy As a concrete example of the development of a Naval device, let us take the torpedo which for many years has been purely a Naval weapon and to the production of which the Navy has devoted large sums of money and considerable effort. It would seem that the airplane supplied a natural vehicle for the conveyance of the torpedo At the present stage of the development of that delicate and complicated mechanism, and with conditions as at present, to separate the advancement of the torpedo for Aviation from the development of the plane which is to convey it would appear to be, to say the least, irrational.

Efficiency of Operations

The third heading under which the objections to a combined service may be discussed is that of efficiency of operations. Except in the elementary work of learning to fly, there can be no doubt that the training and operations of the personnel engaged in Naval Aviation are entirely different from the training and operations of those who work overland in conjunction with armies. The useful application of flying is the important detail for the aviator in war, and of the difficulties with which the Naval Aviator contends the soldier can have no knowledge. Of the difference in the character of the problems presented to the military and naval services, he is entirely uninformed. The details of communications and of position finding are of paramount importance. The aviation arm must be employed in combination with our other arms and not independently In battle, unity of command is a first requirement Mutual familiarity with the capabilities of the different arms engaged is, of course, essential How this can be obtained upon the day of action unless brought together in preparation for battle when training is being given, is not evident.

Attention is invited to the statement which follows, made by a distinguished leader, bearing upon this subject. The Navy and those concerned with Naval Aviation in the United States are in accord with the statements of these high authorities and with the arguments advanced by those whose remarks are quoted.

Numerous methods have been suggested, any one of which might be followed in the building up of this new branch and for the promotion of civil aviation which, of course, must supply the backbone of the aviation arm.

At present it must seem evident that the most economical and the simplest is that which we should utilize.

The problem of developing aviation, of placing the new industry upon its feet, and of overcoming the inertia of service conservatism, must be attacked directly Legislation should give to each department of the Government employing aviation an organization for dealing with aviation matters which will permit their complete cooperation.

Having secured similar organizations in the various departments, immediate steps to prevent duplication and to insure coordination in progressive development between the various services are required. To this end must be legalized a board or committee, composed of representatives of all departments of the Government utilizing aviation and of civil interests, which has definite and legal responsibility for the coordination of the aviation work of the different departments and of avoiding duplication. Every department of the Government which can find a use for aviation should be encouraged to employ it, for at this time and for some years to come the development of the infant industry and of the new art must depend primarily upon Governmental support.

In view of past history it is unreasonable to expect our country to maintain a national military aviation organization

British Airship Moored to a Mooring Mast at Pulham, England

Photo International

adequate to prevent invasion or to supply a sufficient reserve of military and naval flying personnel for the purposes of the furtherance of national policies, extending to distant corners of the globe Both the Army and the Navy, therefore, are vitally concerned in the promotion of civil aeronautics. Through its advancement, technical and inventive talent, industrial facilities for the production and operation of planes, together with the development of skilled man power in great strength, all valuable military assets, are provided Successful civil inventive genius must be recognized through competition in the design and operation of aircraft promoted by the government, and suitably rewarded. The enactment of laws for the licensing of pilots and the inspection of machines, thereby making for safety and for the promotion of interest in flying, is the plain duty of our legislative bodies.

The following statement is an extract from a letter written by Admiral Wm. S Sims, U S N., president of Naval War College, to the Chief of Naval Operations —

Admiral Sims' Views

"Very careful consideration has been given to the developments that have occurred in aeronautics before, during and since the outbreak of the World War Air power must logically be regarded as a very essential component of sea power and in consequence, any consideration of the future development of the Navy must necessarily include a consideration of air power

"The maximum of success in naval warfare can be achieved only by the coordinated employment of all types of naval craft, and such coordination is possible only when all of these several types of craft are operated by personnel trained and indoctrinated along similar lines and in one common school, which is the fleet

"In so far as the future employment of air power in connection with sea power can reasonably be foreseen, it appears certain that battle fleets in future will be accompanied by airplane-carrying ships, similar to those already in service abroad, and that the capital ships themselves will, in addition carry a limited number of airplanes Generally speaking, these planes will be used either offensively against enemy capital ships (torpedo planes with fighting planes for protection) or for reconnaissance work (scouting planes), and for controlling gunfire.

"Air forces operating over the land must cooperate, strategically and tactically with land forces—the Army; and, similarly, air forces operating over the sea must cooperate strategically and tactically with naval forces—the fleet, and the latter must, therefore, be trained by and operated under the command of the naval commander responsible for the execution of the combined naval operation

"Army aviators must be a part of the Army; they must have army training; they must be thoroughly indoctrinated in the methods and operations of all branches of the Army; likewise, naval aviators must be a part of the Navy, they must have naval training, they must be thoroughly indoctrinated in the methods and operations of all types of naval craft; and they must speak and comprehend the language of the sea.

"Army aviation, due to its rapid development during the World War, has reached a stage where operations are more or less standardized, and most of the types of aircraft required have been determined upon with a very considerable extent of accuracy. Naval aviation, on the other hand, was greatly restricted in its operations during the World War, and, in consequence, is still in the experimental stage. Its progressive development is imperative and, to be efficient, it must take place under the responsible control of the Navy.

"The Fleet Air Force of the future will consist of one or more divisions of airplane-carrying ships; and it will be just as much an integral part of the fleet as the Submarine Force or the Destroyer Force This force must, therefore, be operated by personnel thoroughly indoctrinated with the views of the commander-in-chief, in order to achieve unity of command so essential to success.

"The flying skill of the most expert airmen would be of little use to the Navy unless they were seamen and sea-flyers in the sense that they had been trained *with* the fleet, and indoctrinated *by* the fleet, to understand and carry out the intentions of the commander-in-chief Moreover, the nautical training with the fleet and by the fleet is wholly essential to the development of the naval planes and all the appliances by which they can be most efficiently handled by the airplane carriers. This necessity for naval aviators trained by the fleet is shown in all the tactical games in which planes are used, that is, those officers who handle the planes do so in accordance with the nautical and tactical knowledge derived from their naval training and experience

"In view of the foregoing, and after mature deliberation on this subject, I am absolutely opposed to any measure whatsoever looking to the amalgamation of the U. S. Army and Naval air services."

Germans Hide Airplane Parts

The skill the Germans employ in secreting airplane equipment in violation of the treaty of Versailles is frequently giving rise to amusing incidents according to reports The latest of these occurred in one of Hugo Stinnes's Berlin factories, where interallied control officers agreed to inspect the three lower floors of a six story building in the morning and the other three floors after luncheon

All went well until one of the French officers during the afternoon returned to the second floor for a notebook he had dropped there. To his surprise he found the employees of the place during the luncheon hour had transferred there sixty complete motors from the upper rooms.

Gen. Nollett, head of the control commission has reported a case of a German school mistress who fell under suspicion by the control experts. Although she protested that she did not know an airplane part from a pretzel, forty magnetos were discovered under her kitchen table When officers tried to open what was supposed to be a child's bedroom this patriotic Frau dramatically placed herself in front of the door. The officers found fifty complete propellers, a score of magnetos and numerous barometric appliances.

Not the least striking feature of this case arose a few days later when the woman demanded damages to the amount of 200,000 marks for violation of the privacy of her domicile, but Gen Nollett personally interpreted the treaty's clauses for the German judges and the case was dropped.

Monthly Report of Air Mail Service

December, 1920

Division	Gas	Grease and Oil	Repairs and Accessories	Misc.	Motor Cycles Trucks	Heat Light Fuel Power Telephone, and Water	Office Force and Watchmen	Pilots	Mechanics and Helpers.	Departmental Overhead Charge	Interest on Investment	Total
New York—Washington	$3 059 00	$363 69	$5 397 71	$1 845 21	$1 252 17	$616.74	$1 031 04	$1,177 60	$3 428 00	$541 33	$588.75	17,645.24
St Louis—Twin Cities	2 321 39	642 15	2,747 44	3,428 33	375 31	525.46	2 454.50	2,691 33	4,269 44	725 59	1,261 13	22,408 78
New York—Cleveland	3 436 31	302 06	2 446 04	3 007.24	331 01	613 73	1 921 20	6,238 20	6,269 57	403 72	1 402 62	18,325.02
Cleveland—Chicago	1 600 54	413 50	749 10	1,047 38	404 11	235 31	1.443 14	1,982 53	1,320 30	302.70	501 27	11,314 78
Chicago—Omaha	1 302 44	200 22	1,233.30	1,012.31	409 14	125.23	1 211 20	1,664 80	1,399 37	463.72	1 343 34	11,178.35
Omaha—Salt Lake	4 713 00	1,137 55	164 10	2,304 34	720 73	482 00	1 006 54	2,645 32	2,520 16	1,007.75	473 07	24,642 32
Salt Lake—San Francisco	3 601.35	501.97	5,304 00	5 448 92	715.35	352 22	2 645.48	2 424 32	2,009 03	723 54	723.37	24,332 00
Totals and Averages	$17,744 40	$3,814 04	$21,072 43	$21 528 17	$5 184 62	$3 664 75	$12,210 22	$16,813 07	$20 564 00	$4 631 01	$3 133.20	$131,205.86

Service and Unit Cost

Division	Gal of gas	Total time run hr	min	Total miles run	Miles run per gal of gas	Cost per hour	Cost per mile
New York—Washington	3,473	138	13	16,564	2 6	$128.33	$1 00
St Louis—Twin Cities	7,322	272	57	17,122	2.4	82.35	1 31
New York—Cleveland	9 013	264	52	14 471	2 1	94 37	1 25
Cleveland—Chicago	5 380	110	22	15 082	2.8	98 23	84
Chicago—Omaha	3,704	170	48	15 815	4 2	64.43	70
Omaha—Salt Lake	13 220	409	26	25 103	2 7	60 13	98
Salt Lake—San Francisco	7,601	255	23	23 812	3 1	95 00	1 06
Totals and Averages	49,044	1360	38	131,044	2 6	$83 60	$1 00

Cost Per Mile

Division	Overhead	Flying	Maintenance
New York Washington Division	$.35	$.33	$.32
St Louis-Twin Cities	.34	.64	.51
New York-Cleveland	.24	.64	.37
Cleveland-Chicago	.33	.31	.20
Chicago-Omaha	.21	.20	.30
Omaha-Salt Lake	.18	.27	.36
Salt Lake-San Francisco	.20	.24	.52
Entire Service	$.33	$.29	$.48

Average cost of daily service	$1 00 per mile
Damage through crashes, etc., based on million mile operation	.64 per mile
Total cost including overhead, direct operations, interest and all losses	$1 64 per mile

Planes Operated

New York Washington Division
Curtiss R-4's, equipped with Liberty 12
Curtiss JN-4D equipped with Curtiss OX 5 (used for testing pilots)
De Havilands, equipped with Liberty 12

St Louis-Twin Cities Division
Standard, equipped with Hispano-Suiza
Curtiss JN-4 s, equipped with Hispano-Suiza
Twin De Havilands, equipped with two Liberty 6's.
Martin, equipped with two Liberty 12's.

New York-Cleveland Division
Curtiss R-4 s, equipped with Liberty 12
De Havilands, equipped with Liberty 12
Twin De Havilands, equipped with two Liberty 6's

Cleveland-Chicago Division
De Havilands, equipped with Liberty 12
Twin De Havilands, equipped with two Liberty 6's.
Martin, equipped with two Liberty 12 s.

Chicago- Omaha Division
De Havilands, equipped with Liberty 12
Twin De Havilands, equipped with two Liberty 6's.
Junkers (J. L. Larsen), equipped with B. M. W

Omaha-Salt Lake Division
De Havilands, equipped with Liberty 12

Salt Lake-San Francisco Division
De Havilands, equipped with Liberty 12.

Air Meet at San Francisco

San Francisco's flying season opened on Jan. 23 with a big aviation meeting in which twenty-five airplanes, both Army and civilian participated.

Five of the entrants took part in a 35-mile race, four of them army planes from Mather Field, Sacramento, and Walter Varney's big Bristol. The race, twice around Fort Baker, to Lime Point, circling Alcatraz Island and back to the Marina, was won by Flying Cadet Woodgard in a De Haviland plane, in 9 minutes and 55 seconds.

Among the local airmen that participated in the meet were Walter T Varney, Sam Purcell, Doc. Johnson, Joe Durham, Mike Doolin, Shirley Brush, Earl P. Cooper, Cloyd Clevinger, A W. Claverie, "Spike" Eldridge, Danny Davidson and Charlie Hambaugh.

A crowd estimated at 10,000 eagerly watched the performance

Diagrams of Airplane Stability

In this report (N.A.C.A No. 95) a study is made of the effect on longitudinal and lateral oscillations of an airplane of simultaneous variations in two resistance derivatives while the remainder of the derivatives are constant. The results are represented by diagrams in which the two variable resistance derivatives are used as coordinates, and curves are plotted along which the modulus of decay of a long oscillation has a constant value The same type of analysis is also carried out for the stability of the parachute. For longitudinal stability it is concluded that a decrease in η is unfavorable to stability but it may be offset by a variation in the other derivatives. The effect of a spring flap is discussed that will change ξ from its usual value of 0 to either a positive or negative quantity It is found that a positive value of ξ is unfavorable to stability. It is also found that an increase in the value of ξ is unfavorable to stability, and that, if ξ is made positive, the time of damping is decreased In lateral stability it is found that the greater the value of ξ the greater is the effect on the damping of a change in w, and then an increase in w decreases the time of damping, but does not greatly alter the period. When $\xi = 0$ an increase in η decreases the time of damping and increases the period, but when ξ is positive the effect seems to be reversed. An increase in ϵ widens the gap between the curves and $t = a$ constant, and to greatly increase the period when $\xi = 1$ and $\eta = 2$. The effect of a decrease in η seems to be a slight change in curvature of the curve $t = a$ constant. In discussing the stability of a helicopter it is concluded that the gyroscopic effect on stability will be greater than in the case of the airplane

A copy of Report No 95 may be obtained upon request from the National Advisory Committee for Aeronautics, Washington, D C

The Air Service and Civilian Aeronautics

By H. E. Hartney

Captain, Air Service, Chief, Civil Affairs Division, Training and Operations Group, Air Service

"Tactical success in war" is the "raison d'etre" of the Air Service as of any other branch of the Army. It is for this purpose that the Air Service exists. The Training and Operations Group has under its jurisdiction the instruments, including units, personnel and material, that will bring about this tactical success of the Air Service. It is a recognized fact that there are two functions for aircraft in war. One, service to the Army, co-operating with troops on the ground, the other, what might be termed independent or combatant. Army units and in comparison with that portion of the Air Service that operates as an auxiliary to the Army many times larger in numbers, more highly complicated in organization and tactical control and more mobile than the other auxiliary that is purely and distinctly Army Air Service.

Under the Army Re-organization Act of June 14, 1920, only sufficient Air Service was provided to suit Army needs. With the exception of a very small nucleus of pursuit, bombardment and attack, no provision was made for the maintenance of the independent or air force side of military aviation. It became quite evident that from a financial standpoint, if from no other, the Chief of Air Service would have to adopt a policy of maintaining a small but highly efficient Army Air Service depending for the strength on mobilization in an emergency upon the large reserves of personnel and a well established aeronautical industry for its material out of which will be built the combatant forces. This meant that commercial aviation had to be fostered in much the same way as the merchant marine.

With the beginning of the fiscal year on July 1, 1920, one finds little or no organized commercial industry in the United States. No legislation existed that would warrant the promotion of a large air transportation company, although in reality many small operators had sprung up and were struggling along throughout the country in a more or less independent manner, unrecognized by any Government body, uncontrolled either by State or Federal legislation, at best a temporary proposition, hanging on until that time when their efforts would be appreciated as a national asset in a legitimate industry

In the course of its training and maneuvers the Air Service constantly came in touch with the private enterprise and it is only natural to find it acting in many specific localities as a big brother to some small operator With no extra expense the War Department found itself in a position whereby it could assist in the building up of a commercial reserve, furnishing as it were for their benefit certain unused by-products of the daily routine of the Air Service activities. These by-products included mainly information on aeronautical subjects, landing fields recognized and used by the Army, and such other assistance of this nature as legally can be furnished the struggling operator

Undoubtedly commercial aviation will, if left to itself, grow and become of its own impetus a healthy component of the nation's machinery. But under the influence of the Army Air Service it will grow more quickly and at the same time be organized and built up in such a way that it can readily, in the event of an emergency, be trained to good use by the nation. Just as the Training and Operations Group must provide for the building up and organization of the reserve unit, so it must look out for this potential reserve, and on Aug 28, 1920, a recommendation was made to the Executive embracing the new division and outlining the functions of the group as they were construed at that time. This was approved, with certain changes, by the Executive on Sept. 8, 1920, and the Training and Operations Group in a memorandum dated Sept. 14, 1920, set forth suggested changes for Pamphlet 10 and outlined the functions of Civil Affairs and the internal organization thereof.

Further conferences with the Advisory Board were been held on this subject to define clearly the functions of commercial aviation as carried on in the Information Group and in Civil Affairs. The Information Group sends out such data on commercial aviation as is a matter of fact or record, while the Civil Affairs Division, as part of the Training and Operation Group, fosters commercial aviation in conjunction with the regular activities of the Group, sending out opinions or advice based upon actual operations and working out, where necessary, new problems. The Civil Affairs Division has access, through the Chief of Training, to all troops and planes of the Air Service and must at all times consider plans with a view to recommending such changes as may produce results that will foster commercial aviation

Capt. Hartney, until Nov 1, was unable to devote his full time to the organization of the Division because of the fact that he was Acting Chief of Operations, but since the return of the Alaska flyers he has been able to devote his entire time to the Division

Legislative Section

All recommendations for legislation made by the Chief of Air Service must in due course go to the War Department. This section is concerned, therefore, only with such legislation as will enable the operators of aircraft in the Army to foster commercial aviation.

During the life of the division the only control the Air Service has been able to exert over the commercial operator is to insist on the obedience to Army rules for civilian planes upon landing on Government fields and by urging where possible, the use of the standard flying and airdrome rules of the Air Service now in force at all its activities. In several cases this has been done so that virtually the Chief of Air Service does exercise a certain control over the commercial operator Until such time as legislation designates a body for this purpose the work of this section will be extremely small

Airways Section

The function of this section is to construct and supervise airways, municipal landing fields, advise on forest patrol and all other civilian activities of the Air Service. During the period Sept. 25 to Dec. 31 one of the accomplishments of the division has been the preparation of a project for the development of airways throughout the whole of the United States by the Corps Area Commanders and stations under them, the work to be in the ordinary course of training and maneuvers. This project has been submitted to the Chief of the Group and has received his approval

The construction of a model airway is under way, the work on this particular case being assigned to Bolling Field The model airway is in the nature of an experiment which will permit of the necessary orders to all the Corps Area Commanders in due course. The Commanding Officer of Bolling Field is cooperating with the Chambers of Commerce and other municipal organizations en route. The radio development which is to occupy such an important part in the success of the route will of necessity be slow This requires further training of the personnel interested and this includes pilots. Some of the equipment is not yet manufactured, but progress has been made on the installation in the planes of the necessary antenna and with the location of a field at Wheeling and the erection of a hangar there, it will be possible to actually start radio operations, at first reporting weather conditions and communicating with Langley, Mitchel, Bolling and Dayton, later establishing communication with the planes themselves.

Some of the other projects of this section are worthy of note, for their influence on the development of commercial aviation will be far reaching and serve as a background to the subsequent development. These projects are as follows:

Development of Aeronautical Maps. In conjunction with the Information Group and the Navigation Experimental Offi-

Capt Charles Nungesser, Second Ace of the French Air Force, Now Visiting America
Photo International

eer at McCook Field this division is recommending certain changes in the conventional signs now in use for marking maps. This is the first step taken by this division toward obtaining for flyers a suitable map that will be beneficial not only to the military pilot but to the commercial as well With the establishment of the airways it will be possible to work up a very satisfactory flyers' map using oblique and vertical views to show the landing fields.

Aerial Photography in Connection With City Planning: This is a subject that has received some attention in France and England, but very little as yet in this country Several applications from cities have been received by the Chief of Air Service, the last being from Macon, Ga., but it has not been possible as yet to lend any assistance for this important work

Aerial Photography in Connection With Agriculture: This promises to be a very important phase of flying wherein the War Department can stimulate a demand for commercial planes A communication was addressed to the President of the Massachusetts Agricultural College, at Amherst, which received his hearty approval and which is being checked over by him with a view to the Air Service conducting certain experiments in the course of its maneuvers for the stimulating of this important phase of aviation, which may increase the production of agricultural products in the country and tend toward better, scientific farming

Development of Air Lanes for Dirigibles The heavier-than air portion of the Air Service has developed certain routes across the continent, but owing to the very nature of the airships themselves and the fact that they must select routes both from a meteorological and topographical standpoint, it is not strange to find a local engineer applying to this division for the best possible route for dirigibles across the continent. This data is being worked up in co-operation with the Weather Bureau and the Topographical Branch of the Geological Survey of the Interior Department.

Development of Commercial Planes. It is the opinion of many authorities that aviation would have made faster progress in this country and indeed in all countries had it not been that the flyer was burdened with the surplus war material and forced to use uneconomical motors and planes for commercial purposes, for those planes having a high speed and performance from a military standpoint were wholly inefficient from a dividend-paying standpoint. The same people suggest that Germany, stripped of all her military surplus airplanes, will surge ahead over other nations, less favored, and that the taking over of planes under the terms of the armistice will defeat itself Whether or not this contention is correct, the fact remains that there are in existence post-war designed planes which, from a commercial operator's standpoint, are much more satisfactory, more reliable, more economical and capable of landing on and getting off smaller landing fields. There being no real industry or market in this country for these planes, it is difficult for the manufacturer to divert the necessary work to the construction of a plane that would fill these requirements. This division proposes to get in touch with manufacturers, ascertain what, if any, proposals they have in this connection, co-ordinate those and issue an advisory pamphlet on the matter

Aeronautical Insurance. Before commercial aviation can be considered a sound, legitimate business proposition, it will be necessary to have aircraft insurance This division is working with the National Aircraft Underwriters Association toward this end

Forest Fire Patrol A great deal of work has been done in forest fire patrol in the Ninth Corps Area, but little or none elsewhere Demands from other localities in the United States are forthcoming and in some cases have actually arrived. It will be necessary, therefore, for the Air Service to balance off these requisitions upon its services and establish a priority list consistent with location of troops, equipment and training program.

Foreign Aeronautical Trade Development Work of this nature would tend to stabilize the airplane manufacturing industry The opinion of this Group is obtained by the Supply Group on declaring property surplus and as this property should be used to good advantage in foreign countries, such as those of South America, where it is essential that the American aircraft industry penetrate, it is felt that this division can further commercial aviation by looking out where possible for extension of the trade in South America and other foreign countries.

Aerial Contests for the Stimulation of Aeronautical Development All nations that are developing their air forces are considering the offering of prizes for the stimulation of aviation. England last year, through the Air Ministry, awarded prizes to manufacturers for improved design This country has done little or nothing in this connection, other than the awarding of prizes for speed contests, such as the Pulitzer Trophy Race held on Nov 25 last In a communication to the Los Angeles Chamber of Commerce a very interesting and at the same time adequate system for awarding prizes is indicated and it is felt that by the institution of this scheme in various localities throughout the country a very great stimulus to aeronautical development will accrue to the good of the War Department.

Timber Cruising: In connection with airplane work over forest areas, it has been found that a company in Canada employs an American with airplanes for timber cruising and that they have had very great success and that it is a paying aeronautical commercial enterprise. Steps have been taken by this division to introduce this where possible in this country

Grand Canyon Development A request has been received by the Secretary of War from the Secretary of the Interior asking for airplane co-operation in the Grand Canyon, for geological work and for an estimate as to whether or not commercial planes might operate in the Canyon successfully for carrying passengers and viewing the world-famed wonders of the Canyon from the air in this manner The Superintendent of the Park and the Secretary of the Interior have just disapproved a plan for the construction of cable lines throughout the Canyon, designed to obtain this end. It is felt that the airplane can do this better and with greater safety and without detracting from the grandeur of this natural, national monument. A project is being prepared whereby an airplane

will be sent from the Eigth or Ninth Corps Area to the Canyon to spend two weeks looking over the possibilities, finding landing fields and generally making an estimate so that subsequent action can be taken

Co-operation with Boy Scout Organization: The Chief of the Group feels that a great field of activity that will stimulate obtaining a reserve lies with the Boy Scout organizations of the country These organizations have in the past rendered very valuable service by guarding airplanes over night where pilots have been forced to land away from airdromes, and by rendering other useful assistance to stranded aviators The National Council of Boy Scouts in New York realizes that their forces can render a great aid to the nation and the Chief of Air Service feels that work to the mutual benefit of both can be accomplished with little, if any, cost to the Government. Therefore a project is now being prepared by this Division whereby scout organizations of the country will co-operate with the Air Service and the first great work that they will be asked to do is the marking of the landing fields on the model airway

Photographic Section

The Chief of this Section, Lieutenant Wheeler, has, in addition to his responsibility as Chief of the Photographic Section, been required to answer for all photographic activities in the Group Following are activities which have been performed by this section which are particularly valuable in the aid of commercial aviation

Manual of Aerial Photography The official Air Service manual of aerial photography was prepared by the Photographic Section and published in tentative form under date of July 18, 1920, as Air Service Information Circular, Volume 1, No 96

Work of Photo Sections The nine authorized photo sections are designated and located as follows Photo Section No 1, El Paso, Tex ; Photo Section No 2, Kelly Field, Photo Section No 4, Post Field, Photo Section No 6, Camp Stotsenburg, Philippine Islands, Photo Section No 7, Langley Field, Photo Section No 11, Luke Field; Photo Section No 12, France Field, Photo Section No 14, Mitchel Field, Photo Section No 15, Crissy Field In addition to the usual work done by the photo sections, including all photographic work necessary at the fields where they are located and the making of mosaics, the sections in Texas have co-operated with the Corps of Engineers in the making of photographs for use in preparation of military maps. Other sections, namely Photo Sections Nos. 7, 14 and 15, have devoted their operations very largely to the making of aerial photographs of coast defenses. The making of these pictures of all the coast defenses in the United States was directed by the Adjutant General of the Army at the request of the Chief of Engineers and the Chief of Coast Artillery At present this work is almost half completed.

The 4th Photo Section did the necessary aerial Photographic work in connection with the Air Service—School of Line Maneuvers at Fort Leavenworth, Kansas, consisting principally of the making of a photographic mosaic of the reservation, and individual aerial photographs for various uses in connection with maneuvers. Later, this section made a mosaic of the Artillery Firing Center at Camp Knox, Kentucky

Work in and near Washington Aerial photographic work in and near Washington has been performed by photographic personnel from Langley Field, and that on duty in the office of the Chief of Air Service, for the use of the Secretary of War, Surgeon General, Chief of Motor Transport Service, Chief of Engineers, Officer in charge of Public Buildings and Grounds, Fine Arts Commission, and the Chief of Balloon and Airship Division of this Group.

Photographic Work in New York State Two photographic officers were sent from the photographic school to Mitchel Field, from which they made excellent aerial photographs of the New York City river and harbor front, which were used in connection with the plans for the improvement of New York harbor These officers then proceeded to Rochester, N Y and co-operated with the Eastman Kodak Company in testing a new type of aerial camera. This co-operative work has been productive of much valuable information to the Air Service.

Photographic Work by the Alaskan Flight: The Photographic Section gave advice as to the kind of photographic equipment needed by the Alaskan Flight, and originated the orders for the procurement of the equipment and material, and at the same time arranged for the instruction of two of the officers assigned to the flight to receive instruction in the use of one of the newer models of the aerial cameras carried by the expedition While conditions did not permit of the making of a large number of aerial photographs, some very excellent and interesting photographs were, however, secured by this expedition.

International Rifle Matches. A photographic officer was sent from the Air Service Engineering Division to Camp Perry, Ohio to demonstrate the usefulness of aerial photography at the International Rifle Matches held at Camp Perry. Some excellent photographic work was done.

Co-operation with the Mapping Departments: The photographic Section has co-operated with the Corps of Engineers in the preparation of detailed plans for the making of aerial photographs to be used in preparing a map of the Tennessee River Basin in Tennessee The Chief of the Photographic Section represented the Air Service at a conference on this subject held in the Office of the District Engineer, U. S A., at Chattanooga, Tennessee.

The Chief of the Photographic Section was appointed a member of a sub-committee of the standing committee on photographic surveying of the Board of Surveys and Maps of the Federal Government, and as such assisted in the preparation of a report on the application of aerial photography to map making This report is a comprehensive and valuable survey of the subject and as many requests have been received for copies of it, steps have been taken to have it published as an Air Service Information Circular

The Photographic Section has also co-operated with the Geographic and Topographic Divisions of the U S Geological Survey The co-operation with the Geographic Division has consisted in furnishing airplane facilities and aerial photographs to an expert geographer of the Survey, for use in the intimate study he is making of the application of aerial photography to geography. The co-operation with the Topographic Division of the Geological Survey has embraced the making of aerial photographs for the use in the revision and preparation of topographical maps. Requests from the Geological Survey on hand at present involve the photographing of more than 45,000 square miles of territory, the separate areas being located in most of the states of the Union. This work is being engaged upon to the very limited extent that trained Air Service photographic personnel permits.

Similarly the Air Service is co-operating with the U S Coast and Geodetic Survey by making aerial photography for their use in the revision and preparation of maps or charts issued by that Service. Compliance with the requests on hand from the Coast and Geodetic Survey will necessitate the photographing of upwards of 2500 miles.

Commercial Application of Aerial Photography All efforts possible are being made to assist commercial concerns engaged in the making of aerial photographs and in the manufacture of aerial photographic apparatus. To this end, a comprehensive statement as to the policy governing photographic work in the Air Service is being prepared for submission to the Chief of Air Service.

Miscellaneous Efforts are being made to keep in close touch with the developments of aerial photographic equipment and methods abroad. Sample lenses and cameras manufactured in other countries are being purchased for use in connection with developmental work in the Air Service.

The need of the Air Service for a control photographic laboratory and negative repository to be located as near Washington, D C as possible has been called to attention and detailed plans are now in course of preparation.

Steps have also been taken toward the preparation of an official Air Service Manual on the interpretation of aerial photographs. This will involve the compilation of valuable information which at present is scattered, not only throughout the Air Service, but even among several branches of the Army.

Practical instructions or working directions for the use of the new Air Service camera known as type K-1, were prepared and issued in stenciled circular form to all Air Service photographic activities.

United States Civil-Service Examination

Aeronautical Draftsman, National Advisory Committee for Aeronautics

The United States Civil Service Commission announces an open competitive examination (No. 127) for aeronautical draftsman. Vacancies in the Langley Memorial Aeronautical Laboratory, Langley Field, Hampton, Va., at the salaries indicated below, and in positions requiring similar qualifications, which will be filled from this examination, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion

Citizenship and sex.—All citizens of the United States who meet the requirements, both men and women, may enter this examination, appointing officers, however, have the legal right to specify the sex desired in requesting certification of eligibles.

Basis of ratings.—Competitors will not be required to report for examination at any place, but will be rated upon their education and experience as shown by the sworn statements in their applications and corroborative evidence.

Grades and requirements—The register of eligibles will be divided into four grades, the compensation, duties, and minimum requirements for eligibility for each grade being as stated below. The compensation within the range stated for each grade will depend upon the qualifications of the appointee as shown in the examination.

Grade 1, $1,200 to $1,600 a Year

Duties—The duties of this grade require the services of draftsmen for tracing and for some detailing from aircraft or engine layouts.

Requirements—Applicants must show

(a) That they have completed a common-school education and have had four years' experience as copyist or apprentice draftsman, or in lieu of each six months of such experience, applicants may substitute each successfully completed year in high school or in a mechanical or electrical engineering course in a college or university of recognized standing; and

(b) Except in the case of graduates in mechanical or electrical engineering, at least six months of the required experience must have been spent in copying and detailing from aircraft or high-speed internal-combustion engine drawings, or mechanical assembly drawings.

Grade 2, $1,600 to $2,000 a Year

Duties—The duties of this grade require the services of draftsmen for detailing from aircraft or engine layouts.

Education and experience—Applicants must show that they possess the following qualifications:

(a) A good common-school education and four years' experience as mechanical draftsman, or in lieu of each six months of such experience applicants may substitute each successfully completed year in high school or in a mechanical or electrical engineering course in a college or university of recognized standing; and

(b) One year's experience as mechanical draftsman, performing detailing from aircraft or high-speed internal-combustion engine drawings or mechanical assembly drawings, or one and one-half years' experience in general layout and detailing of special machinery or machine tools.

Grade 3, $2 000 to $2,400 a Year

Duties.—The duties of this grade require the services of draftsmen for detailing and for some work in assisting on the preparation of notes, checking plans and specifications, making sketches and drawings of aircraft or engine layouts.

Education and experience.—Applicants must show that they meet the requirements for Grade 2 and that they have had one year's additional experience as mechanical draftsman, six months of which were spent in detailing of aircraft or high-speed internal-combustion engine drawings or mechanical assembly drawings, or nine months of which were spent in general layout and detailing of special machinery or machine tools.

Grade 4, $2,400 to $2,800 or over a Year

Duties—The duties of this grade will require the services of draftsmen for preparing notes and recommendations, for checking plans and specifications, making sketches, designs, and drawings in connection with engines, aircraft, and their accessories.

Education and experience—Applicants must show that they meet the requirements for Grade 3 and that they have had one year's additional experience as mechanical darftsman, six months of which were spent in detailing of aircraft or high-speed internal-combustion engine drawings or mechanical assembly drawings, or of which nine months were spent on general layout and detailing of special machinery or machine tools.

Age.—Applicants must have reached their eighteenth but not their seventieth birthday on the date of the examination. In view of the retirement act, should the appointing officer so request certification will not be made of eligibles who have reached their fifty-fifth birthday

Retirement.—Classified employees who have reached the retirement age and have served fifteen years are entitled to retirement with an annuity The retirement age for railway mail clerks is 62 years, for mechanics and post-office clerks and carriers 65 years, and for others 70 years. A deduction of 2½ per cent is made from the monthly salary to provide for this annuity, which will be returned to persons leaving the service before retirement with 4 per cent interest compounded annually

Photographs.—Applicants must submit with their applications their unmounted photographs, taken within two years, with their names written thereon Proofs or group photographs will not be accepted. Photographs will not be returned to applicants.

Applications—Applicants should at once apply for Form 1312, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C, the Secretary of the United States Civil Service Board, Customhouse, Boston, Mass., New York, N Y., New Orleans, La., Honolulu, Hawaii, Post Office, Philadelphia, Pa., Atlanta, Ga., Cincinnati, Ohio, Chicago, Ill., St Paul, Minn., Seattle, Wash, San Francisco, Cal., Old Customhouse, St. Louis, Mo; Administration Building, Balboa Heights, Canal Zone, or to the Chairman of the Porto Rican Civil Service Commission, San Juan, P R.

Applications should be properly executed, excluding the medical and county officer's certificates, and must be filed with the Civil Service Commission, Washington, D. C, prior to the hour of closing business on March 29, 1921

The exact title of the examination, as given at the head of this announcement, should be stated in the application form

Preference—Applicants entitled to preference should *attach to their applications* their original discharge, or a photostat or certified copy thereof, or their official record of service, which will be returned after inspection by the Commission.

Aeronautical Courses

The following colleges, universities and schools are giving courses in aeronautics

Academy of Applied Aeronautics, Irving Park Boulevard & Western Ave., Chicago, Ill; Brooklyn Polytechnic Institute, Brooklyn, N. Y, Castle Girls School, Tarrytown-on-Hudson, N Y, College of the City of New York, New York City, University of Colorado, Boulder, Colo; Culver Military Academy, Culver, Ind; California Institute of Technology, Pasadena, Cal; Kansas State Agricultural College, Manhattan, Kans, Massachusetts Institute of Technology, Cambridge, Mass.; University of Michigan, Ann Harbor, Mich.; Pennsylvania State College, State College, Pa., University of Pennsylvania, Philadelphia, Pa., Purdue University, Lafayette, Ind., University of Southern Minnesota (College of Engineering), Austin, Minn., Tufts College, Tufts, Mass.; State College of Washington, Pullman, Wash, University of Illinois, Urbana, Ill., Worcester Polytechnic Institute, Worcester, Mass.

The following have courses in preparation Georgia School of Technology, Atlanta, Ga., Iowa State College, Ames, Ia., Ohio State University, Columbus, Ohio., State University of Oklahoma, Norman, Okla.; Oregon Agricultural College, Corvallis, Ore.; Sheffield Scientific School of Yale University, New Haven, Conn.

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